# Age, growth and reproduction of the Shabut *Barbus grypus* (Cyprinidae) in Atatürk Dam Lake (Euphrates River), Turkey

by

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**ABSTRACT**. - Age, growth and reproduction of 243 shabut *Barbus grypus* Heckel, 1843 in Atatürk Dam Lake in Turkey were studied from June 2004 to July 2005. The population was composed of 13 age classes. Age groups, 4-6 for females and 2-4 for males, were dominant. The total length and weight of the individuals ranged from 145 to 960 mm in length and from 40 g to 11 kg respectively. The regression model fitted to the relation between length (FL) and weight (W) of fish was Log W = -4.6112 + 2.8835 Log FL ($r^2 = 0.989$) for females, and Log W = -4.8607 + 2.9679 Log FL ($r^2= 0.990$) for males. The von Bertalanffy growth equations for females and males were found as $Lt = 134.65\ [1 - e^{-0.10038\ (t + 1.85731)}]$ for females and $Lt = 106.77\ [1 - e^{-0.13649\ (t + 1.095)}]$ for males. The total observed sex ratio was: 1.34 (females/males). The spawning period extended from May to July. Fecundity ranged from 16,000 to 235,784.

**RÉSUMÉ**. - Âge, croissance et reproduction des shabuts *Barbus grypus* collectés dans le lac-réservoir du barrage Atatürk, en Turquie.

L'âge, la croissance et la reproduction de 243 shabuts *Barbus grypus* Heckel, 1843 collectés dans le lac-réservoir du barrage Atatürk, en Turquie, ont fait l'objet d'une étude entre juin 2004 et juillet 2005. La population étudiée comprenait 13 classes d'âge, les catégories d'âge 4-6 pour les femelles et 2-4 pour les mâles étant prédominantes. Les longueurs totales et les poids totaux des échantillons étaient respectivement compris(es) entre 145 et 960 mm pour la longueur, et entre 40 g et 11 kg pour le poids. Les modèles de régression respectivement choisis pour la longueur (FL) et le poids (W) des poissons ont été : Log W = -4,8607 + 2,9679 Log FL ($r^2 = 0{,}990$) pour les mâles, et Log W = -4,6112 + 2,8835 Log FL ($r^2 = 0{,}989$) pour les femelles. Les équations de croissance de von Bertalanffy obtenues pour les mâles et les femelles ont été respectivement $Lt = 106{,}77\ [1 - e^{-0{,}13649\ (t + 1{,}095)}]$ et $Lt = 134{,}65\ [1 - e^{-0{,}10038\ (t + 1{,}85731)}]$. Les mâles prédominaient, particulièrement dans les groupes d'âge les plus âgés, et le sex-ratio a été de 1:1.34 (F:M). La période de ponte s'est étendue des mois de mai à juillet. La fécondité a varié entre 16000 et 235784.

Key words. - Cyprinidae - *Barbus grypus* - Turkey - Atatürk Dam Lake - Growth - Reproduction.

The Atatürk dam lake has a total area of 817 km$^2$, being the biggest reservoir in Turkey, and it has a high potential in fishery. About 28 species and subspecies belonging to 8 families inhabiting the Euphrates River and its dammed lakes (Kuru, 1979; Bozkurt, 1994). Some species in the reservoir have economical value (Oymak *et al*., 2001; Başusta and Çiçek, 2006).

The shabut, *Barbus grypus* Heckel, 1843 is a large cyprinid, which occurs along the Euphrates and Tigris Rivers in Turkey, Syria and Iraq (Mahdi, 1967; Kuru, 1978-79; Coad, 1996) and is abundant and commercially important. The scientific interest in this species was mostly concentrated on its taxonomy and distribution (Gruvel, 1931; Beckman, 1962). Karaman (1971) revised *Barbus* species, and *Barbus grypus* was placed in the genus *Tor*. *Tor grypus* was approved by Turkish scientists as a valid species (Kelle, 1978; Kuru, 1979; Kuru, 2004). Coad (1996, 1998) placed the species in the genus *Barbus* in a systematic revision of Iran freshwater fishes. However, little information on the age, growth and reproduction of the shabut is available.

Several studies have investigated *B. grypus* in Iraq: Khalaf *et al*. (1984), Al-Hakim *et al*. (1981) and Szypula *et al*. (2001) studied the growth, age and sexual maturity of *B. grypus* in a number of Iraqi lakes; Peyghan *et al*. (2001) and Rahemo (2004) studied the parasites of *B. grypus*; and Al-Hassan (1984) studied the comparative electrophoretic of the muscle and eye lens proteins of *B. grypus*. In addition, Zivotofsky and Amar (2006) stated the ancient properties of *B. grypus* according to the Talmut. There is no available information regarding the biological characteristics of the shabut in Turkey. The present paper aims to determine age, growth and reproduction characteristics of the shabut, *B. grypus* from Atatürk Dam Lake, Turkey.

## MATERIALS AND METHODS

The shabut were obtained monthly from June 2004 to July 2005 from Atatürk Dam Lake (Fig. 1). In total, 243 adult fishes (104 females and 139 males) were caught by

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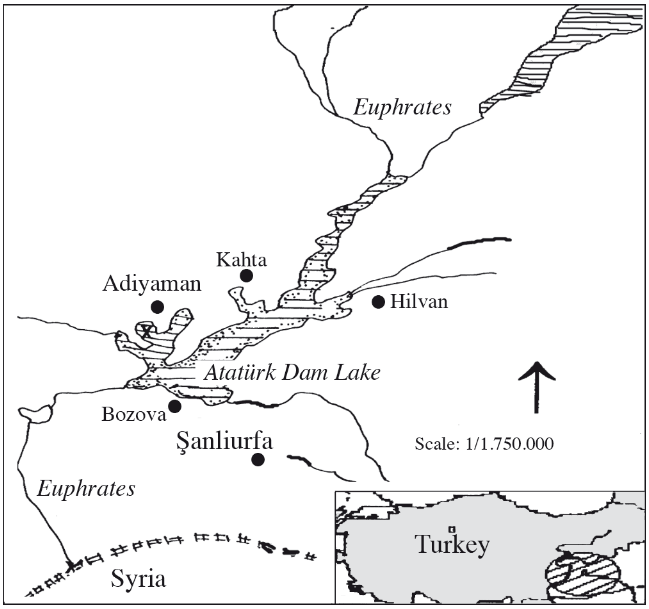

Figure 1. - Map of the study area. *[Carte de la zone étudiée.]*

using gill-nets of five mesh sizes. All individuals were thawed, washed, and excess moisture was removed with absorbent paper. Fork length (mm), total weight (g), and sex were recorded. Scales were removed from each fish and cleaned in a 5% sodium hydroxide solution for age analyses according to Chugunova (1959).

The chi-square test was used to determine whether the age composition differs between female and male and to compare sex ratios in total specimens studied. The von Bertalanffy (1938) growth equation was used to determine the relationships between age-length:

$Lt = L\infty\,[1 - e^{-K(t - t_0)}]$ where $L_t$ is the length at age $t$; $K$ is a constant determining the rate of change in the length increment; and $t_0$ is the hypothetical age when length is zero.

The regression equation for the length-weight relationship was estimated by the least squares method with log-transformed data by the equation: $W = aL^b$ where $W$ is the body weight (g) and L is the fork length (FL, mm) (Le Cren, 1951; Tesch, 1968). Analysis of covariance (ANCOVA) was used to determine the effects of sex on the weight-length relationship. The t-test was performed to evaluate the difference of the b slope of length-weight relationship from 3 (Arslan *et al.*, 1995). Statistically significant differences were considered at $p < 0.05$.

The condition factor ($K$) was estimated for males and females using the equation:

$K = W \times 10^3/L^3$ where $W$ is the body weight (g) and L is the fork length (mm) (Tesch, 1968). Two-way ANOVA was used to evaluate the effects of months and sexes on the condition factor. Tukey's HSD test was used for multiple comparisons after ANOVA (Zar, 1996).

The gonads were removed and weighed to the nearest 0.01g. The monthly gonado-somatic index (GSI) was calculated by: GSI = Gonad weight (g) / Body weight (g) x 100 (Pantulu, 1963).

The number of eggs was estimated by the gravimetric method using ovaries, which had been preserved in 4% formalin solution (Laevastu, 1965) in order to enumerate the total number of eggs in the particular ovary (absolute fecundity). From each ovary twenty ova were selected randomly and measured with a micrometer eye-piece and egg diameter measurements were averaged for all specimens. The relationship between body weight (W) and gonad weight was determined by regression analysis.

The relationships between fecundity-length and fecundity-weight indicated a curvilinear relationship that was best fit by a polynomial regression model. The following polynomial regression equations were used to determine the relationships between fecundity-length and fecundity-weight:

$F = F_0 + aL + bL^2$ *and* $F = F_0 + aW + bW^2$

where $F$ = number of eggs, $L$ = fork length (mm) and $W$= body weight (g) (Jorge *et al.*, 2000).

## RESULTS

### Age and sex composition

The population of the shabut in Atatürk Dam Lake was represented by thirteen age groups, from $1^+$ to $13^+$. The oldest fish in the study was $13^+$ years old amongst the males (890 mm FL, 10 kg) and a 12 years old female (960 mm FL, 9 kg). Fish samples in age groups were statistically different for both sexes ($\chi^2 = 80.316$, $p < 0.0001$). Age groups, 4-6 for females and 2-4 for males were dominant. (Fig. 2). The total observed sex ratio was 1:1.34 (females/males) and it differs significantly from the theoretical 1:1 value ($\chi^2 = 4.757$, $p = 0.0292$).

The weight and length frequency distributions are pre-

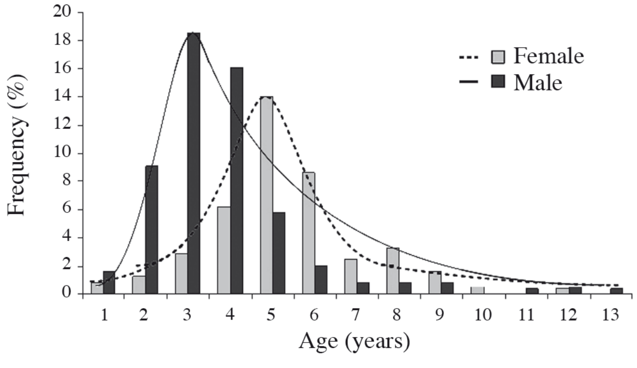

Figure 2. - Distribution of age of *Barbus grypus* from Atatürk Dam Lake, Euphrates basin, Turkey, from June 2004 to July 2005. *[Distribution des âges des* B. grypus *collectés dans le lac-réservoir du barrage Atatürk pendant la période d'étude.]*

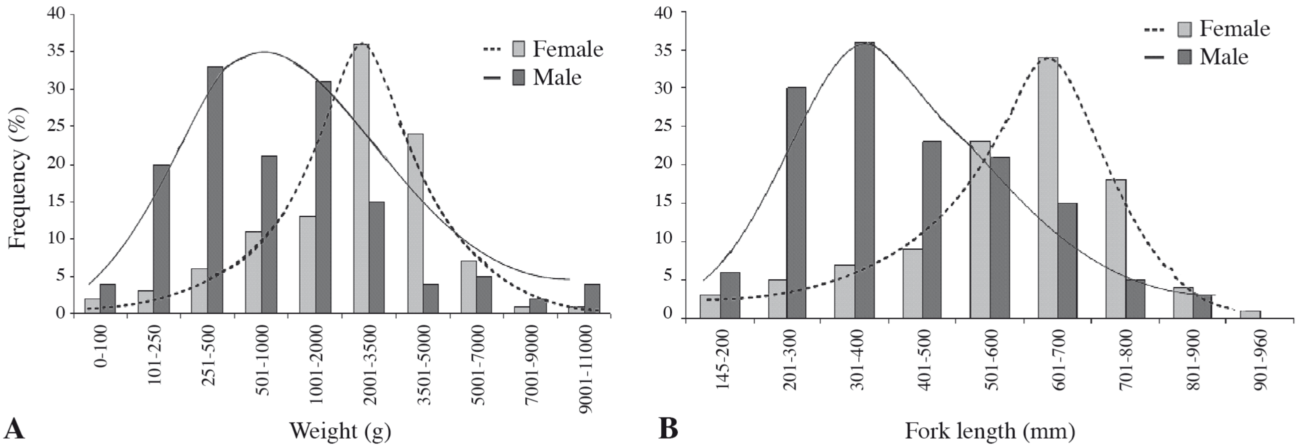

Figure 3. - Weight (A) and length (B) frequency histogram of the shabut in Atatürk Dam Lake, Euphrates basin, Turkey, collected between June 2004 and July 2005. *[Histogramme de fréquence pour le poids (A) et la longueur (B) des shabuts collectés dans le lac-réservoir du barrage Atatürk entre juin 2004 et juillet 2005.]*

sented in figure 3. The weight of samples ranged from 40 g to 11 kg, and most individuals were 2-3.5 kg for female and weighed between 250 and 2,000 g for males. The length distribution ranged from 145 to 960 mm. The weight and length frequency distributions were different in males and females. Most females ranged from 501-700 mm, whereas most males ranged from 201-400 mm. Fish numbers in size-classes > 960 mm were low if not entirely absent.

## Growth

The lengths and weights in the different age groups of the shabut are given in table I. As seen in table I, the differences in the mean length and weight values for the same age groups of males and females were not statistically significant ($p > 0.05$). The length-weight relationships were presented in figure 4. The resulting equations for females and males are given below:

Female : $\text{Log } W = -4.6112 + 2.8835 \text{ Log } FL$ ($r^2 = 0.989$)

Male : $\text{Log } W = -4.8607 + 2.9679 \text{ Log } FL$ ($r^2 = 0.990$)

The length-weight relationships in males and females were found to be different from each other (ANCOVA, $p < 0.05$). The results indicated that for the females, the *b* value (2.8835) was lower than 3 (t-test, $p < 0.05$), indicating a negative allometry for the females, whereas the *b* value (2.9679) for males was not statistically different from 3 showing an isometry for males (t-test, $p > 0.05$).

The results for the von Bertalanffy growth equations derived from length at age data were $L_t = 134.65\ [1 - e^{-0.10038\ (t + 1.85731)}]$ for females and $L_t = 106.77\ [1 - e^{-0.13649\ (t + 1.095)}]$ for males. $L\infty$ values for female and male were 134.65 cm and 106.77 cm (FL), respectively, whereas observed maximum lengths were 96 cm for females and 89 cm (FL) for males.

The mean condition factor was 1.176 for females and 1.152 for males. The condition factors for females of ages 1, 2, 4, 5 and 7 were higher than those given for males (Fig. 5).

The monthly variations in condition factor has shown that the values were the highest in November (1.255), and the lowest in April (1.098) for females, and the highest in July (1.277) and the lowest in May (1.077) for males. The condition factor significantly varied between months in *B. grypus* (ANOVA, F = 1.919, $p < 0.05$) (Tab. II). However, no significant dif-

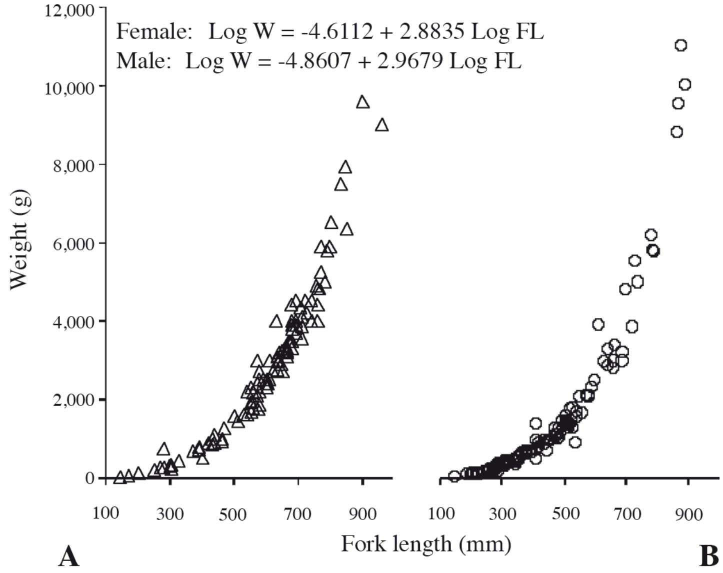

Figure 4. - Observed individual fork lengths-at-weight of the shabut sampled in Atatürk Dam Lake, Euphrates basin, Turkey, collected between June 2004 and July 2005. *[Longueurs à la fourche au poids observées pour les shabuts collectés dans le lac-réservoir du barrage Atatürk entre juin 2004 et juillet 2005.]*

Table I. - Lengths (mm) and weight (g) of the different ages of shabuts, *B. grypus* from Atatürk Dam Lake, Euphrates basin, Turkey, from June 2004 to July 2005. N: number of fish, SD: standard deviation; minimum and maximum values are given in parentheses. *[Longueurs (en mm) et poids des différents âges de shabuts* B. grypus *collectés dans le lac-réservoir du barrage Atatürk. N : nombre de poissons; SD : écart-type; les valeurs minimum et maximum sont données entre parenthèses.]*

| Ages | N | Females | | N | Males | | N | Combined sexes | |
|---|---|---|---|---|---|---|---|---|---|
| | | FL+SD (min-Max) | W+SD (min-Max) | | FL+SD (min-Max) | W+SD (min-Max) | | FL+SD (min-Max) | W+SD (min-Max) |
| 1 | 2 | 157.5 ± 17.7<br>(145.0-170.0) | 51.00 ± 15.56<br>(40-62) | 4 | 185.0 ± 23.8<br>(150.0-200.0) | 78.00 ± 26.98<br>(40-96) | 6 | 175.8 ± 24.6<br>(145.0-200.0) | 69.00 ± 25.51<br>(40-96) |
| 2 | 3 | 250.0 ± 50.0<br>(200.0-300.0) | 207.33 ± 94.35<br>(118-306) | 22 | 252.5 ± 35.8<br>(200.0-310.0) | 188.10 ± 75.82<br>(104-350) | 25 | 252.2 ± 36.5<br>(200.0-310.0) | 190.40 ± 76.24<br>(104-350) |
| 3 | 7 | 322.1 ± 47.3<br>(270.0-400.0) | 392.00 ± 162.37<br>(250-694) | 45 | 328.3 ± 39.9<br>(260.0-410.0) | 426.76 ± 131.87<br>(204-680) | 52 | 327.5 ± 40.5<br>(260.0-410.0) | 422.08 ± 135.08<br>(204-694) |
| 4 | 15 | 446.8 ± 65.6<br>(282.0-550.0) | 1099.6 ± 330.11<br>(718-1700) | 39 | 479.5 ± 46.7<br>(380.0-560.0) | 1182.67 ± 282.21<br>(700-1700) | 54 | 470.4 ± 54.0<br>(282.0-560.0) | 1159.59 ± 295.46<br>(700-1700) |
| 5 | 34 | 609.6 ± 45.9<br>(540.0-690.0) | 2641.18 ± 579.25<br>(1600-3700) | 14 | 602.5 ± 56.9<br>(520.0-690.0) | 2457.14 ± 565.30<br>(1750-3400) | 48 | 607.5 ± 48.8<br>(520.0-690.0) | 2587.50 ± 575.43<br>(1600-3700) |
| 6 | 21 | 670.6 ± 49.6<br>(580.0-760.0) | 3603.33 ± 743.75<br>(2500-4900) | 5 | 660.0 ± 47.4<br>(610.0-720.0) | 3670.00 ± 798.91<br>(2850-4800) | 26 | 668.6 ± 60.7<br>(580.0-760.0) | 3616.15 ± 738.49<br>(2500-4900) |
| 7 | 6 | 670.6 ± 49.6<br>(580.0-760.0) | 4116.67 ± 771.15<br>(3200-5250) | 2 | 725.0 ± 91.9<br>(660.0-790.0) | 4375.00 ± 1944.54<br>(3000-5750) | 8 | 712.5 ± 67.3<br>(650.0-799.0) | 4181.25 ± 989.57<br>(3000-5750) |
| 8 | 8 | 769.4 ± 45.2<br>(705.0-850.0) | 5200.00 ± 884.39<br>(4000-6350) | 2 | 757.5 ± 38.9<br>(730.0-785.0) | 5650.00 ± 212.13<br>(5500-5800) | 10 | 767.0 ± 73.9<br>(705.0-850.0) | 5290.00 ± 805.81<br>(4000-6350) |
| 9 | 4 | 776.3 ± 49.6<br>(740.0-845.0) | 5358.75 ± 1765.35<br>(4000-7935) | 2 | 760.0 ± 28.3<br>(740.0-780.0) | 5600.00 ± 848.53<br>(5000-6200) | 6 | 770.8 ± 80.5<br>(740.0-845.0) | 5439.17 ± 1424.57<br>(4000-7935) |
| 10 | 3 | 843.3 ± 51.3<br>(800.0-900.0) | 7866.67 ± 1582.19<br>(6500-9600) | - | - | - | 3 | 843.3 ± 51.3<br>(800.0-900.0) | 7866.67 ± 1582.19<br>(6500-9600) |
| 11 | - | - | - | 1 | 865.0 | 8800.00 | 1 | 865.0 | 8800.00 |
| 12 | 1 | 960.0 | 9000.00 | 2 | 875.0 ± 7.1<br>(870.0-880.0) | 10250.00 ± 1060.66<br>(9500.00-11000.00) | 3 | 903.3 ± 93.7<br>(870.0-960.0) | 9833.33 ± 1040.83<br>(9000.00-11000.00) |
| 13 | - | - | - | 1 | 890.0 | 10000.00 | 1 | 890.0 | 10000.00 |

Table II. - Results of the two-way ANOVA evaluating the effects of months and sexes on the condition factor in *Barbus grypus* from Atatürk Dam Lake, Euphrates basin, Turkey from June 2004 to July 2005. *[Résultats de l'ANOVA à deux facteurs évaluant les effets des mois et du sexe sur le facteur de condition de* B. grypus *collectés dans le lac-réservoir du barrage Atatürk de juin 2004 à juillet 2005.]*

| Source of variation | d.f. | Mean square | F | P |
|---|---|---|---|---|
| Months | 10 | 5.264 E-02 | 1.919 | 0.044 |
| Sexes | 1 | 5.239 E-03 | 0.191 | 0.663 |
| Months x sexes | 10 | 1.454 E-02 | 0.530 | 0.868 |
| Error | 221 | 2.743 E-02 | - | - |
| Total | 243 | - | - | - |

ferences between sex was apparent (ANOVA, F = 0.191, $p > 0.05$). Condition factors were different only between May and November (Tukey's HSD test, $p < 0.05$).

## Reproduction

The age at sexual maturity of *B. grypus* samples was determined by observation of gonads, starting from January. Age at maturity could be determined in 243 samples (Tab. III). The ages of 50 percent of sexual maturity of shabut were the third year, both for females and males. The first sexually mature females and males weight was 392 g and 426 g, respectively.

The determination of the spawning season for *B. grypus* population in Atatürk Dam Lake was based on the gonadosomatic index values, analysis of yearly variation of mean egg diameter, and direct observation of gonads (Fig. 6). There was a marked individual variation in the pattern of monthly GSI values. According to these average values, the highest GSI values were observed in the samples of May and April. The mean GSI values decreased in July samples because almost all individuals were spawning. Most individual spawning was observed in June. Since a few females retained a few eggs in their ovaries, the mean GSI values increased in October.

The mean egg diameter reached its maximum, 2.183 mm, in January (Fig. 7) while its minimum 0.100 mm was measured in July when the ovaries contain only oocytes.

According to the GSI values, seasonal development in ovaries size, and through direct observation of the gonads, it is concluded that the spawning took place in May and occurred until late June. Fecundity was estimated on 104

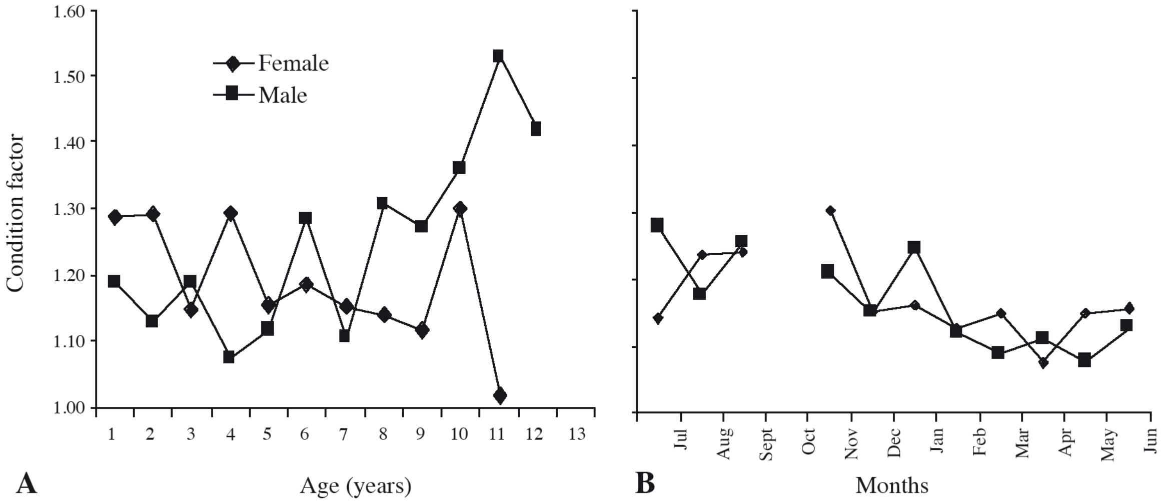

Figure 5. - Mean condition factor in the different ages (A) and monthly fluctuation (B) for males and females of the shabut sampled in Atatürk Dam Lake, Euphrates basin, Turkey, between June 2004 and July 2005. *[Facteur de condition moyen pour les différents âges (A) et fluctuation mensuelle (B) pour les shabuts mâles et femelles collectés dans le lac-réservoir du barrage Atatürk entre juin 2004 et juillet 2005.]*

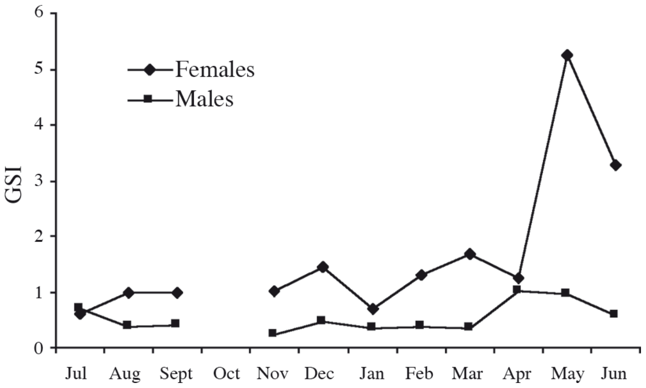

Figure 6. - Monthly variation of gonado-somatic index (GSI) for males and females of *Barbus grypus* in Atatürk Dam Lake, Euphrates basin, Turkey, from June 2004 to July 2005. *[Variation mensuelle de l'indice gonado-somatique (GSI) pour les* B. grypus *mâles et femelles collectés dans le lac-réservoir du barrage Atatürk entre juin 2004 et juillet 2005.]*

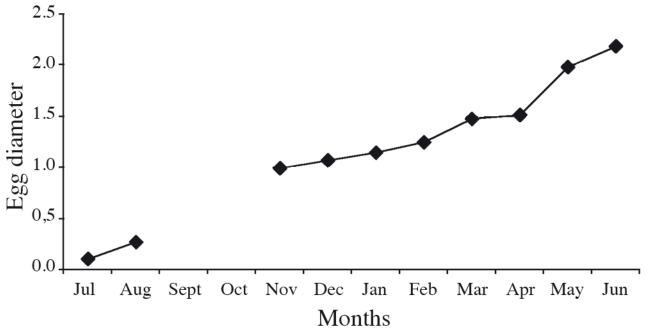

Figure 7. - Monthly eggs diameter of the shabuts sampled in Atatürk Dam Lake between June 2004 and July 2005. *[Diamètre mensuel des œufs des shabuts collectés dans le lac-réservoir du barrage Atatürk entre juin 2004 et juillet 2005.]*

females caught just prior to spawning. The number of eggs ranged from 16,000 to 235,764. The relationships between fecundity and fish length and fish weight of the shabut are given in figure 8. Positive correlation was found between fish length and fish weight *versus* fecundity, and the regression equations are given below:

$F = 75438.34 + -268.387\ L + 0.4219\ L^2$ ; ($r^2 = 0.413$)

$F = 12592.25 + 24.198\ W - 0.0008055\ W^2$ ; ($r^2 = 0.433$)

## DISCUSSION

Scales are most frequently used for age determination of *Barbus* species (e.g. Szypula *et al*., 2001; Al-Hakim *et al*., 1981; Yıldırım *et al*., 2001; Al-Hazza, 2005). As a preliminary study, we also examined other age determination methods, such as opercular bones and vertebra with scales, to recognise and compare the best result. The scales for age determination gave the best result particularly for old individuals compare to other methods.

The captured *B. grypus* specimens from Atatürk Dam Lake were aged between $1^+$ and $13^+$. The average age range of this species has been stated as 0-7 years by Szypula *et al*. (2001) from Tharthar and Habbaniya lakes in Iraq, and 0-16 years by Al-Hakim *et al*. (1981) from Dukan Lake in Iraq. In this study, we found that age depended of the fishing method. Al-Hakim *et al*. (1981) reported similar results in Dukan Lake.

The longest fork length, 990 mm, was measured in a female (age $11^+$). The longest length for this species has previously been given as 690 mm at age 7 by Szypula *et al*. (2001) from Tharthar and Habbaniya lakes, and as 960 mm

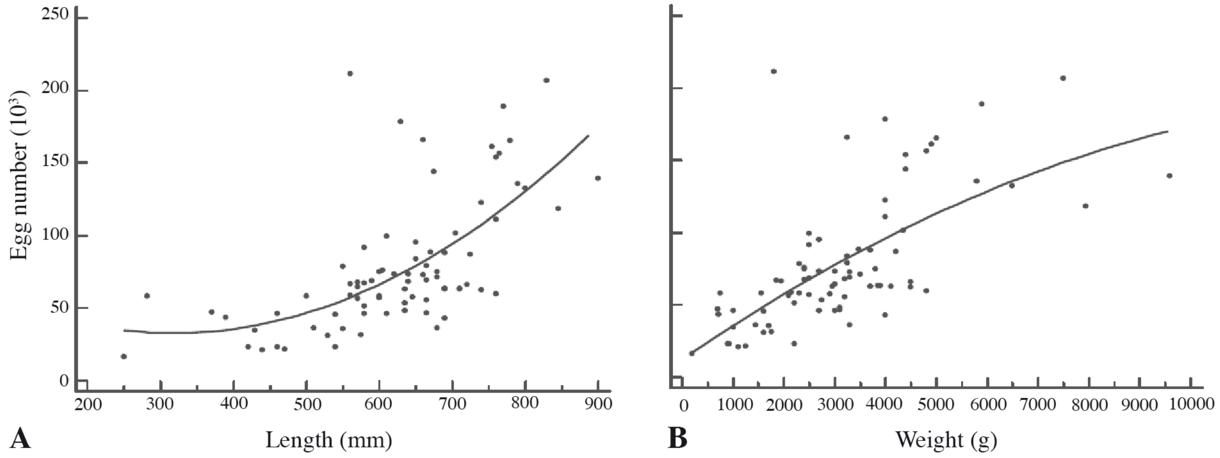

Figure 8. - Relationships between fecundity and fish length, fish weight and gonad weight of the shabuts sampled in Atatürk Dam Lake between June 2004 and July 2005. *[Relations entre la fécondité et la longueur, le poids individuel et le poids des gonades pour les shabuts collectés dans le lac-réservoir du barrage Atatürk entre juin 2004 et juillet 2005.]*

Table III. - Relative abundance of mature and non mature females and males of *B. grypus* from Atatürk Dam Lake Euphrates basin, Turkey, from June 2004 to July 2005, related to age. *[Stade de maturité de* B. grypus *mâles et femelles collectés dans le lac-réservoir du barrage Atatürk, corrélé à l'âge, entre juin 2004 et juillet 2005.]*

| Sex | Stage of maturity | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Female | Imm. (N) | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | - |
| | % | 100 | 33 | 14.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | - |
| | Mat.(N) | 0 | 2 | 6 | 15 | 34 | 21 | 6 | 8 | 4 | 3 | - | 1 | - |
| | % | 0 | 66 | 85.7 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | - | 100 | - |
| Male | Imm.(N) | 4 | 9 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 |
| | % | 100 | 39 | 11.1 | 0 | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 |
| | Mat.(N) | 0 | 14 | 40 | 39 | 14 | 5 | 2 | 2 | 2 | - | 1 | 2 | 1 |
| | % | 0 | 61 | 88.9 | 100 | 100 | 100 | 100 | 100 | 100 | - | 100 | 100 | 100 |

at age 16 by Al-Hakim *et al.* (1981) from Dukan Lake.

The mean weights at age $1^+$ in males and females were 78 g and 51 g, respectively, while the mean weights at age $12^+$ for males and females were 11 kg and 9 kg respectively. Szypula *et al.* (2001) stated the mean weight is 6 g at age $0^+$ and 2,585 g at age 7 from Tharthar and Habbaniya lakes, whereas Al-Hakim *et al.* (1981) stated the mean weight is 38 g for age $0^+$ and 9,700 g for age 16 from Dukan Lake. Based on the findings of the present study the observed lengths were not significantly different between females and males for all age groups. Ali *et al.* (1981) found no sexual dimorphism in their Iraqi samples. However, sexual dimorphism in grow rate are well documented in *Barbus barbus* (Baras, 1994; Prokes *et al.*, 2006).

The results of length-weight relationships in *B. grypus* indicated close to isometric growth for males and negative allometric growth for females. A similar result was recorded in *Eutropiichthyes vacha* from Indus River, Pakistan (Somro *et al.*, 2007). This change may be due to various factors which can affect fish growth, and can include season, habitat, gonadal maturity, sex, stomach fullness, health and/or preservation techniques (Nikolsky, 1963; Tesch, 1968).

The results for the von Bertalanffy growth equations for female and male were, for the $L\infty$ values, 134.65 cm and 106.77 cm, respectively. These values have been stated as 134.3 and 214.7 for combined sexes by Szypula *et al.* (2001) from Tharthar and Habbaniya lakes in Iraq.

The condition factor of the *B. grypus* population was 1.176 and 1.152 for males and females, respectively. The condition factor for this species has previously been given as 0.88 by Al-Hakim *et al.* (1981) from Dukan lake. The condition factor of *B. grypus* increased during summer months and October. From December up to May, the condition factor decreased, before increasing again in June. The increases of the condition factor during these months are due to improvements in the fish nourishment. The sexual maturing age was $4^+$ for females and $3^+$ for males. Al-Hakim *et al.* (1981) found similar results in Dukan Lake.

Ovary development and egg maturity were highest in May; also spawning started in May and became more intensive from June to July. It was observed that egg number increased with age. This situation has also been observed in other cyprinids (Ünlü *et al*., 1994). According to Jobling (1995), reproductive potential must increase with the increasing age and size of the fish.

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